

FOOD HABITS OF THE LANNER FALCON (*FALCO BIARMICUS FELDEGGII*) IN CENTRAL ITALY

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ABSTRACT.—The diet of the Lanner Falcon (*Falco biarmicus feldeggii*) was studied in an area of central Italy for one yr. Diet composition differed according to the methodology used for data collection with mammals, small passerines and insects found more frequently or exclusively in pellets. Conversely, analysis based on pluckings and observations of prey taken to the nest indicated the diet consisted of only nonpasserine and large passerine birds. Overall, the birds including European Starling (*Sturnus vulgaris*), Green Woodpecker (*Picus viridis*), and Jay (*Garrulus glandarius*) were the most common prey taken by Lanner Falcon. Mammals taken included wood mouse (*Apodemus* sp.), common dormouse (*Muscardinus avellanarius*) and Savi's pine vole (*Microtus savii*).

KEY WORDS: Lanner Falcon; *Falco biarmicus*; diet; feeding ecology; Italy.

Habitos alimenticios del *Falco biarmicus feldeggii* en la región central de Italia.

RESUMEN.—La dieta del *Falco biarmicus feldeggii* fue estudiada durante un año en un área de la región central de Italia. Se observó que la composición de la dieta variaba de acuerdo con la metodología utilizada para la recolección de datos, de tal manera que se encontraron pequeñas aves passerinas, mamíferos e insectos más frecuentemente o exclusivamente en las egagrópilas. Por el contrario, al analizar la presa en el nido y al realizar desplumamiento, se halló que la dieta consistía únicamente de aves no passerinas y grandes passerinas. Sobre todo aves como *Sturnus vulgaris*, *Picus viridis*, *Garrulus glandarius*, fueron la presa más común de *F. biarmicus feldeggii*. Los mamíferos incluidos en la dieta eran *Apodemus* sp., *Muscardinus avellanarius* y *Microtus savii*.

[Traducción de Agustina Lanusse]

The European subspecies of the Lanner Falcon (*Falco biarmicus feldeggii*) is limited in its distribution to southern Italy and the Balkans with a population estimated to be just a few hundred pairs (Gensbøl 1992). There are <60 pairs in the Italian peninsula but, in Sicily, the population consists of >80 pairs (Massa et al. 1991). In Tuscany, central Italy, five breeding pairs are known in a 8300 km² area, with a density of 1 pair/1660 km².

The biology of the Lanner Falcon in Europe is poorly studied (Cramp and Simmons 1980). Most work has been done on the African subspecies (Cade 1965, Maclean 1984, Goodman and Haynes 1989, 1992) and very few studies have been conducted in the Mediterranean area (Mebis 1959, Bonora and Chiavetta 1975, Massa et al. 1991). Lanner falcons nest on cliffs, making it difficult to

find perches and roosts where food remains may be collected for dietary studies (Massa et al. 1991, Chiavetta 1992). Apart from studies conducted in Sicily (Mebis 1959, Massa et al. 1991), no detailed research has been done so far on the food habits of Lanner Falcons. Herein, we present results of an analysis of the diet of a pair of Lanner Falcons in central Italy based on remains collected at plucking areas and the nest site and observations of prey delivered to the nest.

STUDY AREA

The study was conducted in a rural area named "Crete Senesi" in Tuscany, central Italy, at 200–300 m elevation. The climate of the area is temperate, locally subarid, with an average annual temperature of 18°C. It is very hilly, open and eroded at the bases of hills which has created an abundance of small clay/sand cliffs ranging from 10–

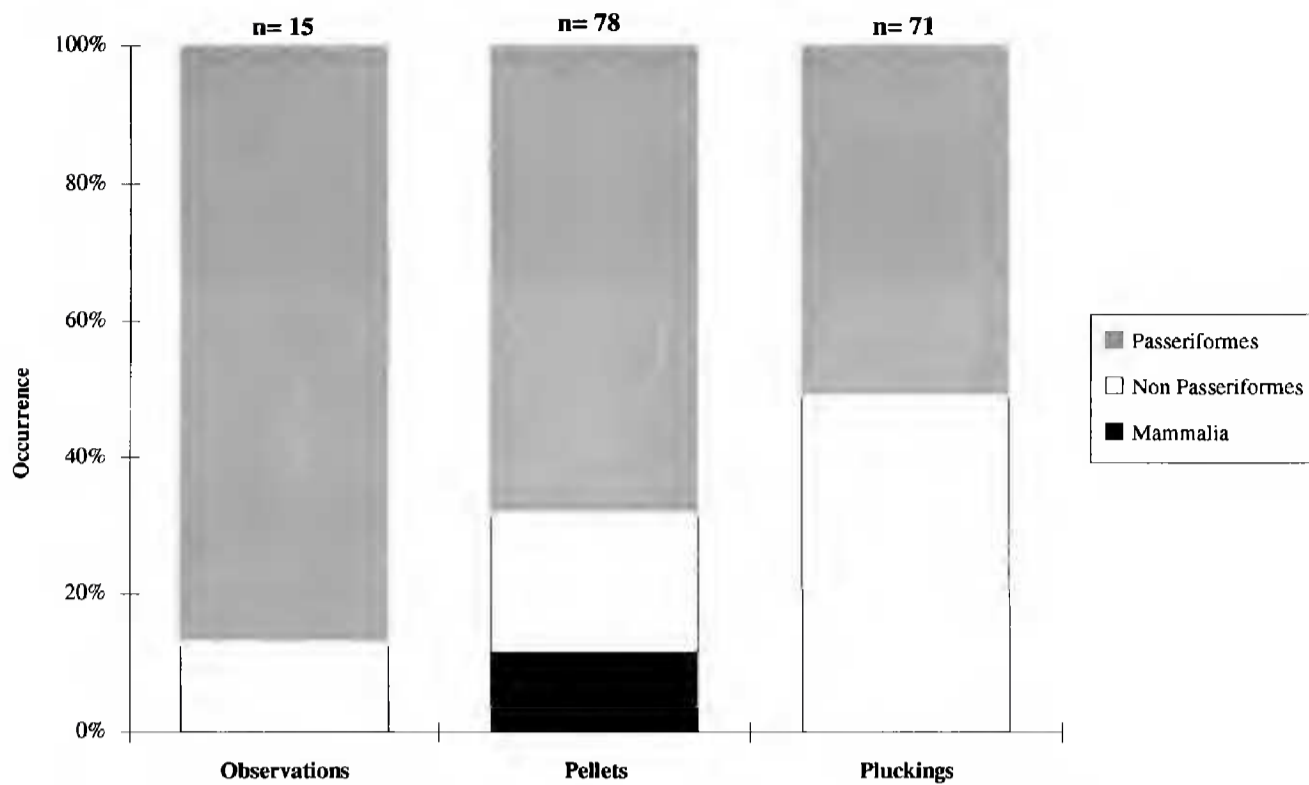


Figure 1. Composition of the diet of Lanner Falcons during the breeding season (December–June) using three different methods: direct observations of prey taken to the nest, pellets, and plucked remains. Numbers above the bars refer to sample size for each method.

40 m in height. These small cliffs are used for nesting by Lanner Falcons (Morimando et al. 1994). The vegetation of the area is dominated by pastureland with small oakwoods (*Quercus pubescens*) interspersed with cereal crops and small patches of olive trees (*Olea europea*).

METHODS

We observed a pair of Lanner Falcons through two reproductive seasons from spring 1994–summer 1995. We made direct observations on prey brought to the nest and we collected prey remains at the bases of nest cliffs. By watching activity patterns, we also found two main perches where the falcons plucked and ate their prey. From June 1994, we collected prey remains at these perches twice a month by searching the ground carefully under each perch. Prey were often identified in the field based on feathers and fresh remains. Remains that were not readily recognized as well as pellets were examined using a dissecting microscope and remains were identified using museum specimens and identification guides (Brown et al. 1987, Svensson 1992). We also used taxonomic keys (Chaline et al. 1974) and a sample of specimens collected locally to compare bones and skeletal remains.

We calculated the % occurrence and % biomass of each prey category in the diet based on each of the three methods. Prey biomass was determined based on the average weight of prey taxa reported in the literature (Cramp 1977–94, for birds; Macdonald and Barret 1993, for mammals). We calculated the mean prey weight (MPW) using the formula: Total Biomass/Total Numbers of each prey species.

RESULTS

We observed the nest 16 times for a total of 96 hr. We also collected plucked remains 26 times and

collected 59 pellets under perches. Altogether, we identified 15 prey items delivered to the nest, 78 prey items from pellets, and 71 prey items from plucked remains (Table 1). The mean number of prey per collecting event was 0.94 prey for observations, 1.32 for pellets and 2.73 for pluckings.

Direct observations at the nest showed that passerine birds were delivered to the nest more frequently than nonpasserines (Table 1). Although most of these birds were not identified, the main prey species taken to the nest appeared to be the European Starling (*Sturnus vulgaris*) and Blackbird (*Turdus merula*). The MPW of prey brought to the nest was 121 g (SE = 38.27). During nest observations, we twice saw the male storing small prey in a cliff hole that was used as a cache.

Nearly identical percentages of passerines and nonpasserines were identified from plucked remains (Table 1). The MPW of prey based on this type of analysis was 182.01 g (SE = 216.94), considerably larger than that of prey taken to the nest ($t = 2.47$, $df = 20$; $P < 0.02$). Based on this type of analysis, the main prey were Green Woodpecker (*Picus viridis*), Jay (*Garrulus glandarius*) and European Starling. Most of the biomass in the Lanner diet was from nonpasserines of which the Green Woodpecker was the largest and most frequently taken species.

Bone fragments in pellets were small and diffi-

Table 1. Numbers (N), percentage of biomass (%B) and percentage of occurrence (%O) of prey items in Lanner Falcon diet in Tuscany, Italy, according to collecting methods.

PREY ITEM	PELLETS			PLUCKINGS			OBSERVATIONS		
	N	%B	%O	N	%B	%O	N	%B	%O
MAMMALS									
<i>Muscardinus avellanarius</i>	1	0.38	1.28	0	0	0	0	0	0
<i>Apodemus</i> spp.	3	0.96	3.85	0	0	0	0	0	0
<i>Microtus savii</i>	1	0.38	1.28	0	0	0	0	0	0
<i>Rodentia</i> ind.	4	0.9	5.13	0	0	0	0	0	0
Total mammals	9	2.62	11.54	0	0	0	0	0	0
BIRDS									
<i>Falco tinnunculus</i>	0	0	0	4	6.19	5.63	0	0	0
<i>Phasianus colchicus</i>	0	0	0	2	10.83	2.82	1	38.57	6.67
<i>Columba livia</i>	3	11.49	3.85	7	16.25	9.86	1	16.53	6.67
<i>Columba palumbus</i>	1	5.74	1.28	1	3.48	1.31	0	0	0
<i>Streptopelia turtur</i>	1	19.1	1.28	3	3.48	4.23	0	0	0
<i>Athene noctua</i>	0	0	0	1	1.08	1.41	0	0	0
<i>Apus apus</i>	0	0	0	1	0.31	1.41	0	0	0
<i>Picus viridus</i>	11	35.10	14.10	16	30.95	22.54	0	0	0
Total nonpasserines	16	54.24	20.51	35	72.58	49.30	2	55.10	13.33
<i>Alauda arvensis</i>	0	0	0	2	0.57	2.82	0	0	0
<i>Turdus merula</i>	6	6.13	7.69	1	0.62	1.41	3	13.22	20
<i>Turdus philomelos</i>	0	0	0	3	1.58	4.23	0	0	0
<i>Garrulus glandarius</i>	0	0	0	11	14.47	15.49	0	0	0
<i>Pica pica</i>	3	6.89	3.85	3	4.18	4.23	0	0	0
<i>Corvus monedula</i>	0	0	0	0	0	0	1	10.74	6.67
<i>Sturnus vulgaris</i>	37	28.33	47.44	11	5.11	15.49	5	16.53	33.33
<i>Emberiza calandra</i>	0	0	0	1	0.29	1.41	0	0	0
<i>Anthus pratensis</i>	0	0	0	1	0.14	1.41	0	0	0
<i>Passeriformes</i> ind.	7	1.79	8.97	3	0.46	4.23	4	4.41	26.67
Total passerines	53	43.14	67.95	36	27.42	50.70	13	44.90	86.67
Total birds	69	97.38	88.46	71	100	100	15	100	100

cult to recognize. Nevertheless, this form of analysis showed that mammals also occur in the diet of the Lanner Falcon (Table 1). Mammals identified were wood mouse (*Apodemus* spp.), common dormouse (*Muscardinus avellanarius*) and Savi's pine vole (*Microtus savii*). Also, some pellets were made solely of insects remains, mainly Formicidae and small Coleopterans. A careful inspection of pellets showed that most insects were inside the gizzard remains of Green Woodpeckers and Starlings. Passerines were the most frequent prey found in pellets, but nonpasserine species accounted for slightly more biomass using this method of analysis. Main prey species represented in the pellets were the European Starling, Green Woodpecker and Blackbird. The MPW in pellets was 100.44 g (SE =

163.01) which was smaller than the MPW found in pluckings ($t = 2.80$, $df = 20$; $P < 0.01$).

Medium-sized passerines ($\bar{x} = 98.41$ g) and large nonpasserines ($\bar{x} = 268.70$ g) were the primary species found in plucked remains. In pellets, mammals ($\bar{x} = 22.71$ g) and mainly passerines of small size ($\bar{x} = 63.70$ g) were present. Small passerines ($\bar{x} = 62.69$ g) and few nonpasserines of large size ($\bar{x} = 265.62$ g) were taken to the nest. The differences among plucked remains, pellets and direct observations as to the three main categories of prey found (passerines, nonpasserines and mammals), were highly significant ($\chi^2 = 13.46$, $df = 4$, $P < 0.009$).

DISCUSSION

We concluded that use of a single method to determine the diet of Lanner Falcon biases the re-

sults. Data from plucking sites provided more information about diet composition per searching effort than other collecting methods. Pellets are also important because they provided more complete information on the composition of prey, especially that of mammals and insects. Direct observations of prey taken to the nest appear to be unnecessary since they add little to quantitative information on the Lanner Falcon's diet. The use of plucking data alone may result in overestimates of large- and medium-size birds, as generally longer and heavier feathers fall directly beneath the perches, while the light feathers of small birds tend to disperse (e.g., in the wind). Analysis of pellets alone tends to overestimate the amount of small passerines and mammals. Lanner Falcons generally swallow small birds almost entirely, whereas they tear flesh and feathers from larger birds. This probably accounts for the high frequency of small passerine remains found in pellets. We feel that it would be best to evaluate information obtained from all the collecting methods to most accurately assess the diet of Lanner Falcons.

We found the diet of Lanner Falcon in central Italy to be qualitatively different from that of Lanner Falcon in other areas. Birds comprised 88–100% of the diet in our study area depending on the method of diet analysis used. These results were consistent with those of Cramp and Simmons (1980), except we found for the first time that Green Woodpecker is taken by Lanners. We also confirmed that they eat small mammals but that they do not appear to eat reptiles and insects as reported by Massa et al. (1991). In Sicily, birds (90.4%), reptiles (4.1%) and mammals (2.7%) are in the diet of Lanners (Mebs 1959), with Jackdaw (*Corvus monedula*), Lesser Kestrel (*Falco naumanni*) and feral Pigeon (*Columba livia*) preyed upon the most. Magpie (*Pica pica*) and Spanish Sparrow (*Passer hispaniolensis*) are also preyed upon in Sicily (Massa et al. 1991) and small mammals and reptiles account for only a small percentage of the diet (4% and 2.3%, respectively).

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